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Diagnosis and surgical treatment of colonic obstructive foreign bodies in chinchillas (*Chinchilla lanigera*): a case series (2017–2020)

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ABSTRACT. We describe a case series of colonic foreign bodies in seven chinchillas. These animals had all shown complete lack of fecal output. Ultrasonography was performed in each case, revealing a hyperechoic foreign body with strong acoustic shadowing in the bowel in 6 of the 7 cases (86%). Foreign bodies were removed under exploratory laparotomy in all cases, with a perioperative survival rate of 71% (5/7). The foreign bodies were extracted from the distal ansa of the ascending colon (n=3), descending colon (n=3), or intermediate part of the ascending colon (n=1). This case series suggests chinchillas are affected by colonic obstructive foreign bodies and surgical intervention may be necessary to pursue better prognosis in cases where medical therapies prove ineffective.

KEYWORDS: chinchilla, *Chinchilla lanigera*, foreign body, gastrointestinal disease, intestinal obstruction

Chinchillas (*Chinchilla lanigera*) are rodents belonging to the *Chinchillidae* family and are bred in captivity and kept for the fur-trade and biomedical research, and as companion animals [8, 10]. These animals are strict herbivores and hindgut fermenters, and so possess a long gastrointestinal tract (total length of the colon and rectum is often over 2 m) [8, 10, 14, 21]. Gastrointestinal disease is the major cause of morbidity and mortality among farmed chinchillas, and gastrointestinal pathologies resulting from any systemic disease and inappropriate husbandry remain a frequent and important problem among pet chinchillas [8, 10, 14, 27]. Gastrointestinal foreign bodies in this species have been poorly documented in the literature, so descriptions of antemortem diagnosis and treatment of foreign bodies are rare [14, 19]. This report aimed to describe the clinical signs, imaging and biochemistry findings, and medical and surgical treatments with outcome data for 7 chinchillas presenting with colonic obstructive foreign bodies.

Cases 1, 2 and 3 were brought into a clinic with a chief complaint of anorexia, decreased fecal output, soft feces, and abdominal pain. These chinchillas were alert with mildly decreased activity and had been received pharmacotherapy for several days on an outpatient basis. However, Cases 1, 2 and 3 were hospitalized on Day 13, 8 and 5, respectively, due to unresolved symptoms and complete lack of fecal output. Cases 4 and 5 were brought into a clinic with a chief complaint of complete lack of fecal output and were hospitalized on Day 1. Case 6 was hospitalized on Day 5 after receiving medical therapy on an outpatient basis, although this case also showed complete lack of fecal output on Day 1. Case 7 had been receiving pharmacotherapy for about 2 months as an outpatient. This case was presented with complete lack of fecal output and was hospitalized. The day of patient hospitalization was defined as day 1 for Case 7 (Table 1). All cases underwent serum biochemical analysis and abdominal palpation multiple times during the clinical course. Precise biochemical panel findings are summarized in Table 2. Common biochemical abnormalities in the early clinical course were hyperglycemia (n=6), increased alkaline phosphatase (n=6), hypokalemia (n=6), increased blood urea nitrogen (n=4), and hyperproteinemia (n=4). Abdominal palpation revealed a firm pellet interpreted as representing a foreign body only in one case (Case 3). All cases showed mild depression with anorexia under hospitalization with medical treatment provided along with abdominal ultrasound and plain/positive-contrast gastrointestinal radiography. Ultrasound revealed a hyperechoic foreign body with strong acoustic shadowing in the bowel in 6 of the 7 cases (Cases 1–6). On longitudinal view, ultrasound showed the bowel dilated with anechogenic fluid proximal to the foreign body (Fig. 1). All foreign bodies apparent on ultrasound were ovoid with the edge of the foreign body outlined by anechogenic luminal fluid. Ultrasound did not show any foreign bodies in Case 7, only revealing localized bowel dilation with anechogenic fluid. Of the 6 cases with foreign body revealed by ultrasound, 5 cases (Cases 1, 2, 4–6) underwent ultrasound multiple times (mean, 3.8 times; range, 2–6 times) during hospitalization. A hyperechoic foreign body was noted each

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Table 1. Clinical signs, image findings, outcome, site of obstruction and length of foreign body

Case	1	2	3	4	5	6	7
Age (years)	3.7	1.9	4.4	5.9	3.3	Approximately 4 or 5	2.3
Body weight (g)	683	382	507	480	549	719	467
Sex	Male	Female	Female	Female	Male	Female	Male
Clinical signs	Anorexia, soft feces	Anorexia, decreased fecal output, soft feces, abdominal pain, mild lethargy	Anorexia, decreased fecal output, mild lethargy	Anorexia, lack of fecal output, mild lethargy	Anorexia, lack of fecal output and decrease in fecal size, mild lethargy	Anorexia, lack of fecal output, mild lethargy	Anorexia, intermittent diarrhea and lack of fecal output, mild lethargy
Plain abdominal radiographic findings	Severe gaseous dilation in small intestine, cecum, colon	Moderate gaseous dilation in cecum	Severe gaseous and fluid-filled dilation in colon	Mild gaseous dilation in cecum	Mild gaseous dilation in cecum	Severe abdominal distention due to impacted ingesta and small, round accumulations of gas in cecum, severe gaseous dilation in colon	Moderate gaseous dilation in colon
Positive-contrast gastrointestinal radiographic findings							
Gastric transit time (hr)	3.3	1.1	19.9	32.4	NT	4.3	1.9
Small intestinal transit time (hr)	19.5	NT	NT	55.4	NT	NT	10.2
Cecum transit time (hr)	34.2	NT	NT	73.4	NT	NT	71.4
Total examination time (hr)	54.0	57.7	109.4	96.3	43.3	29.8	157.4
Onset of complete lack of fecal output	Day 13	Day 8	Day 5	Day 1	Day 1	Day 1	Day 1*
Timing of surgery	Day 15	Day 10	Day 10	Day 7	Day 3	Day 6	Day 8
Outcome	Discharged on Day 23; treatment completed on Day 83	Discharged on Day 16; treatment completed on Day 132	Discharged on Day 18; no follow-up data available, although owner reported uneventful course 14 months postoperatively	Discharged on Day 14; treatment completed on Day 130	Remained with complete lack of fecal output and anorexia; a few small fecal pellets observed on Day 12, but animal died on Day 18	Died 9 hr postoperatively	Died 17 hr postoperatively
Site of obstruction	Distal ansa of ascending colon (ansa distalis coli)	Distal ansa of ascending colon (ansa distalis coli)	Descending colon	Descending colon	Distal ansa of ascending colon (ansa distalis coli)	Descending colon	Intermediate part of ascending colon (pars intermedia)
Length of foreign body (cm)	2.6 × 1	1.9 × 1	4.5 × 1.7	3.4 × 0.9	2.2 × 1.1	2.6 × 1.2	3.3 × 1.9

NT, no transit. *This animal presented with complete lack of fecal output and was hospitalized after receiving pharmacotherapy for about 2 months as an outpatient. The day of patient hospitalization was defined as day 1 for Case 7.

time in 3 cases (Cases 1, 5, and 6). In contrast, a foreign body was not noted on ultrasound once among 4 trials in Case 2 and five times among 6 trials in Case 4. When no foreign body was apparent in these two cases, localized bowel dilation with anechogenic fluid was revealed by ultrasound. Abnormalities in plain abdominal radiography for each case are summarized in Table 1 (Fig. 2). Positive-contrast gastrointestinal radiography was performed during hospitalization along with medical treatment in all cases (Figs. 3 and 4). Barium sulfate suspension (1–3 mL/kg, 200 w/v%, Bamster S200; Kaigen Pharma, Osaka, Japan) was orally administered. Right lateral and ventrodorsal views of the abdomen were taken immediately after administration of contrast medium as well as at approximately 30, 60, and 180 min, and 6 and 12 hr post-administration; and subsequently every 6–12 hr along with the condition of the patient. Gastric transit time, small intestinal transit time, and cecum transit time were determined by recording the time from initial administration of contrast medium to its first appearance in the duodenum, cecum, and colon, respectively. Total examination time was the time from initial administration of contrast medium to the timing of the final radiographic image followed by exploratory laparotomy (Table 1). Gastric transit to the duodenum was noted in all but one case (Case 5). Of these six cases, small intestinal transit to the cecum and cecal transit to the colon were noted in three cases, none of which showed the formation of fecal pellets. As pharmacotherapy, all cases were administered enrofloxacin (10 mg/kg, s.c., q 12 hr, enrofloxacin injection 25 KS for dogs and cats; Kyoritsu Seiyaku, Tokyo, Japan), metoclopramide (1 mg/kg, s.c., q 12 hr, Primperan injection; Astellas Pharma, Tokyo, Japan), famotidine (1 mg/kg, s.c., q 12 hr, Famotidine injection Sawai; Sawai Pharmaceutical, Osaka, Japan), lactulose (1 mL/kg, p.o., q 12 hr, Monilac syrup 65%; Chugai Pharmaceutical Co., Tokyo, Japan), liquid paraffin/white petroleum (1 mL/kg, p.o., q 12 hr, Laxatone; Fujita Pharmaceutical Co., Tokyo, Japan), mosapride citrate (1 mg/kg, p.o., q 12 hr, Pronamide tablet; DS Pharma Animal Health,

Table 2. Biochemical panel findings for colonic obstructive foreign body in 7 chinchillas

Case		1			2			3			4				5			6		7		Reference interval [24]
Day		1	15	15	8	10	10	1	10	10	1	5	7	7	1	3	3	1	6	5	8	
Biochemistry	Units		Preoperative	Postoperative		Preoperative	Postoperative		Preoperative	Postoperative			Preoperative	Postoperative		Preoperative	Postoperative		Preoperative		Postoperative	
Sodium	mM	134	132		151	153		135	154		144		143		146	144		138	122		136	130–155
Potassium	mM	2.7	3.6		3.7	3.6		3.4	4		4.5		2.7		3.4	3.2		3.3	2.5		4.1	5–6.5
Chloride	mM	93	103		113	118		99	128				112		110	114		99	93			105–115
Blood urea nitrogen	mg/dL	16.6	7		39.1	18		34.3	14.2	17.3	63	23.8	30.5	27.1	24.2	18.9	17.6	28.9	89	17.9	17	10–25
Creatinine	mg/dL	0.48			0.64			0.8			0.8		0.75		0.46			0.4	1		0.3	NA
Calcium	mg/dL	5.6	7.1		9.5	9.2		9			7	7.7	6.5		6.2	7.4	6.2	6.7	5.6		5.6	5.6–12.1
Phosphorus	mg/dL	4.2			7.6	7.4		7.5			7.4	3.5	3.9		5.1	8.5	8.7	7.3	14.6		4.5	4–8
Glucose	mg/dL	256	175		143	176		226	261		168		164		280	117	90	262	>600	168	38	60–120
Total protein	g/dL	5	5.5	4.5	5.5	5.5	4.4	6.2	5.6		6.6	5.4	4.1	4.6	6.2	4.3	4	6.6	5.2	5.4	3.3	5–6
Albumin	g/dL	2.9	2.5	2.1	2.9	2.1	2.2	2.3	1.6	2.4	5.4	2.3	1.7	3	3.3	2.1	1.9	2.9	1.8	1.5	1.1	2.4–4.2
Globulin	g/dL	3.1	3	2.4	2.6	3.4	2.2	3.9	4		1.2	3.1	2.4	1.6	2.9	2.2	2.1	3.7	3.4	3.9	2.2	NA
Alanine aminotransferase	IU/L	31			16			21			14		11		18			10	20	11	67	10–35
Alkaline Phosphatase	IU/L	112			339			83			61		136		369			251	408		31	3–47
Aspartate aminotransferase	IU/L																	58	146			96
Total bilirubin	mg/dL	0.5						0.4			0.5	0.3	0.3		0.1						0.4	0.4
Creatinine kinase	IU/L							311			>2,000											NA
Amylase	IU/L										958										866	NA
Triglycerides	mg/dL	68			105			142							125			86	44			117–229.5
Ammonia	μg/dL	112			165	96		103	94		113	71	74		133		82	115	243			NA

NA, not available.

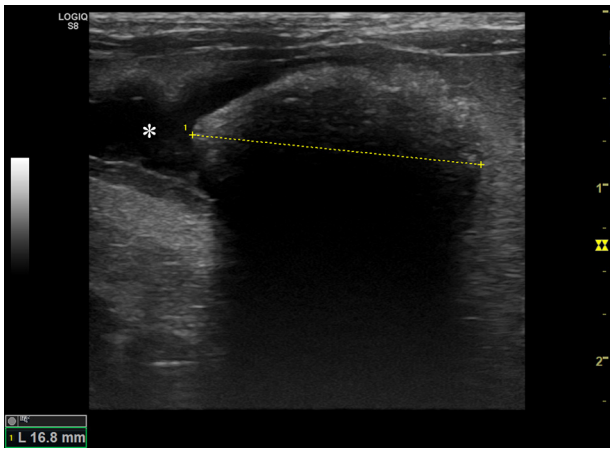

Fig. 1. Abdominal ultrasound image on Day 1 in Case 5. A hyperechoic foreign body with strong acoustic shadowing, measuring 16.8 mm on longitudinal view, is noted. The bowel is dilated with anechogenic fluid (*) proximal to the foreign body, which appears ovoid with the edge outlined by anechogenic luminal fluid.

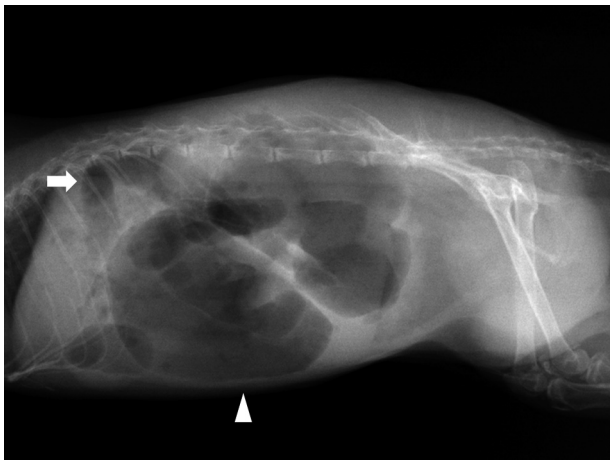

Fig. 2. Plain abdominal radiographic image on Day 13 in Case 1. Severe gaseous dilation of the cecum (arrowhead) and dilated loops of bowel (arrow) are evident.

Osaka, Japan), *Pediococcus* probiotics (0.25 capsules, p.o., q 12 hr, Mito max super for small dogs and cats; Kyoritsu Seiyaku Corp.), and acetated Ringer's solution (20–40 mL/kg, s.c., q 12 hr, Soluacet; Terumo Corp., Tokyo, Japan). In addition to these medications, buprenorphine (0.02 mg/kg, s.c., q 12 hr, Lepetan injection; Otsuka Pharmaceutical, Tokyo, Japan) was administered in Cases 1, 2, and 3 and trimethoprim/sulfamethoxazole (30 mg/kg, p.o., q 12 hr, Baktar combination tablet; Shionogi & Co., Osaka, Japan) was administered in Case 3. Although subcutaneous fluid dose was adjusted according to the condition of the patient, Cases 3, 4, 6, and 7 had shown subcutaneous edema, leading to discontinuation of fluid administration in the middle of hospitalization. Assisted feeding (5–10 mL/kg, q 12 hr, Vet's selection Lifecare for rabbits; Yeaster Co., Tatsuno, Japan) with a syringe was provided in five cases (Cases 1, 2, 4, 5, 7), and was discontinued during hospitalization in four cases (Cases 1, 2, 4, 5) because the patients gradually showed reluctance to swallow. In the remaining two cases (Cases 3 and 6), assisted feeding was not performed due to severe abdominal

Fig. 3. Positive-contrast gastrointestinal radiographic image on Day 14 in Case 1. This right lateral view was taken 19.5 hr after oral administration of barium sulfate suspension. Contrast medium is apparent in the cecum and also remains in the stomach. Severe gaseous dilation of the cecum (arrowhead) is also noted.

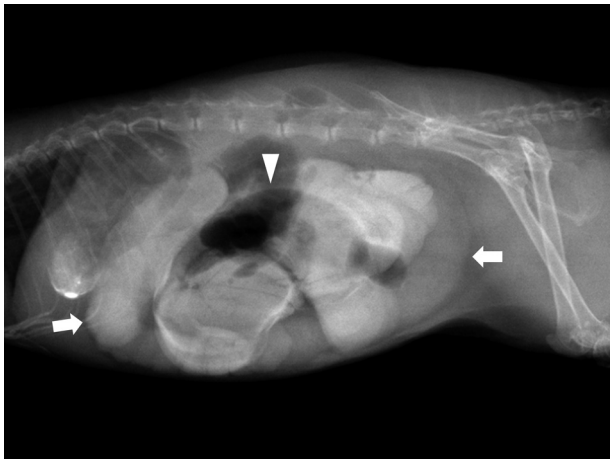

Fig. 4. Positive-contrast gastrointestinal radiographic image on Day 15 in Case 1. This right lateral view was taken 54.0 hr after oral administration of barium sulfate suspension. Contrast medium appears in dilated loops of bowel, which can be interpreted as colon (arrow). The rest of the contrast medium remains largely in the cecum, with some in the stomach. Moderate gaseous dilation of the cecum is also evident (arrowhead). No formation of fecal pellets is evident.

distension. All cases had shown a persistent complete lack of fecal output throughout hospitalization, despite medical treatment. Given these clinical courses, ultrasound and plain/positive-contrast radiography findings, the presumptive diagnosis in each case was intestinal obstruction due to a foreign body.

Exploratory laparotomy was performed in all cases. Biochemical analyses were performed again just before surgery in all but one case (Case 7), showing hypokalemia (n=5), hyperglycemia (n=5), and hypoalbuminemia (n=5) in most cases. Following intramuscular injection of a mixture of 0.25 mg/kg midazolam (Dormicum Injection; Astellas Pharma) and 0.25 mg/kg butorphanol (Vetorphale; Meiji Seika Pharma, Tokyo, Japan), anesthesia was induced with 2% isoflurane and oxygen (2 L/min) via an anesthetic chamber and maintained at 1–3% with a face mask. Abdominal palpation under anesthesia was performed just before surgery in 5 of the 7 cases (Cases 1–5). Of these 5 cases with palpation under anesthesia, a firm foreign body was palpable in 3 cases (Cases 2, 3, and 5). Vascular access was secured in the cephalic vein of the foreleg or lateral saphenous vein of the hindleg using a 26-G indwelling needle, and continuous drip of acetated Ringer's solution was supplied at 10 mL/kg/hr. Cases 3, 4, 6, and 7 showed severe edema in the ventral abdominal skin, mild accumulation of ascites and collapse in peripheral blood vessels with severe hypoalbuminemia as revealed by biochemistry just before surgery. Human serum albumin (HSA) (5 mL/kg, i.v., Albuminar 25% i.v. injection; CSL Behring, Tokyo, Japan) was administered over 30 min in Cases 3 and 4 following prednisolone sodium succinate (1 mg/kg, i.v., Predonine for injection; Shionogi Pharma Co.), while hydroxyethylated starch 70,000 (5 mL/kg, slow i.v., Salinhes fluid solution 6%; Fresenius Kabi Japan, Tokyo, Japan) was given in Cases 6 and 7. Abdominal midline incision and intraabdominal exploration revealed a colonic foreign body in all cases. The foreign body was noted at the distal ansa of the ascending colon (ansa distalis coli) in Cases 1, 2, and 5, in the descending colon in Cases 3, 4, and 6, and in the intermediate part of the ascending colon (pars intermedia) in Case 7 (Figs. 5 and 6). All cases showed severe bowel dilation with luminal fluid proximal to the foreign body and lumen collapse distal to the foreign body. The colonic wall containing a foreign body was adherent to adipose tissue in Cases 3 and 5 (Fig. 6). The colonic wall containing a foreign body in Case 3 seemed viable on visual inspection and palpation, while that of Case 5 showed severe thinning and a patchy pattern of brown and white, suggesting severe ischemia and necrosis. Thickening of the colonic wall containing the foreign body was noted in Case 7. The section of colon containing a foreign body was exteriorized and packed off from the rest of the abdomen with moist gauze. A longitudinal incision was made in healthy-appearing tissue proximal or distal to the foreign body using a No. 11 blade. The foreign body was moved to the incision site by digital pressure and removed. The incision site was closed in a longitudinal direction by simple interrupted sutures with 6–0 polydioxanone (Ethicon PDS II; Johnson & Johnson, Tokyo, Japan). For leak testing, the lumen was distended with sterile saline and gentle digital pressure was applied to confirm the absence of leakage between sutures. Following lavage of the isolated intestine and entire abdomen with warm saline, the peritoneum was closed and subcutaneous tissue was apposed by simple continuous sutures with 5–0 polydioxanone. The skin was closed with simple interrupted sutures using 5–0 nylon suture (ELP; Akiyama Medical, Tokyo, Japan) to complete the surgery. Flumazenil (0.02 mg/kg, i.m., Flumazenil i.v. injection 0.5 mg "TEVA"; Teva Takeda Pharma, Nagoya, Japan) was administered postoperatively in Cases 1 and 2. The foreign body in each case was a firm, compact ball of matted hair forming an elongated oval (Fig. 7). Postoperatively, cases administered HSA (Cases 3 and 4) showed increased albumin compared with preoperatively (Table 2), as well as distension of peripheral blood vessels and disappearance of edema.

Cases 1–5 recovered from anesthesia uneventfully, while Cases 6 and 7 died 9 hr and 17 hr postoperatively, respectively. Cases 1–5

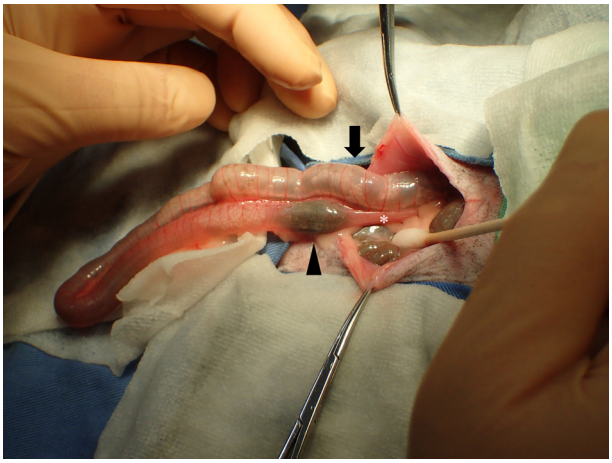

Fig. 5. Colonic obstructive foreign body in Case 2. The bowel is dilated with luminal fluid (arrow) proximal to the foreign body (arrowhead), which is noted in the distal ansa of the ascending colon (ansa distalis coli). In contrast, the lumen appears collapsed (*) distal to the foreign body.

Fig. 6. Colonic obstructive foreign body in Case 3. A firm, comma-shaped foreign body (*) is noted in the descending colon. The bowel is dilated with luminal fluid (arrowhead) proximal to the foreign body. The foreign body is moved distally by digital pressure in advance of the operation. The colonic wall at the site originally obstructed by the foreign body is adherent to adipose tissue (arrow).

Fig. 7. The removed foreign body in Case 3. The foreign body is a firm, compact ball of matted hair.

were administered acetated Ringer's solution (10–20 mL/kg, s.c., q 12 hr), and enrofloxacin, metoclopramide, famotidine, buprenorphine, lactulose, liquid paraffin/white petroleum, mosapride citrate, and *Pediococcus* probiotics using the same route and dose given above. Assisted feeding (10–20 mL/kg, q 8 hr) with a syringe was also provided. In addition to these medications, meloxicam (0.2 mg/kg, s.c., q 24 hr, Metacam 0.2% injection; Boehringer Ingelheim Vetmedica, Japan, Tokyo, Japan) was administered in Cases 1 and 2 and trimethoprim/sulfamethoxazole (30 mg/kg, p.o., q 12 hr) was administered in Case 3. Cases 1–4 showed fecal output postoperatively (mean, 12.3 hr; range, 7–17 hr) and followed an uneventful postoperative course. These animals were discharged after approximately 1 week in hospital (mean, 7.8 days; range, 7–8 days). Due to insufficient appetite and small fecal pellets with decreased amounts, assisted feeding and oral medication at home had been given for Cases 1,2 and 4 until Days 83, 132, and 130 (68, 122, and 123 days postoperatively), respectively, although the animals had been alert with normal activity. Case 3 was not brought in for further treatment for this condition after Day 31, although the owner reported the animal had shown increased appetite and sufficient fecal output soon after discharge and remained clinically healthy as of 14 months postoperatively. Case 5 remained with complete lack of fecal output and anorexia postoperatively. A few small fecal pellets were observed on Day 12, but the animal died on Day 18 (15 days postoperatively).

This report highlights three clinical features of colonic obstructive foreign bodies in chinchillas that have been poorly documented in the literature, although the potential mechanisms underlying formation of a colonic foreign body and its pathogenesis remain unclear. First, abdominal ultrasound is the most useful tool for diagnosing colonic foreign bodies in chinchillas. Second, surgical removal of the colonic foreign body may be necessary to achieve better prognosis in cases where medical therapy proves ineffective. Third, albumin represents a useful tool to assess perioperative risks because most chinchillas with colonic foreign body show severe hypoalbuminemia due to prolonged malabsorption of nutrition from the bowel.

In this case series, abdominal ultrasound revealed a hyperechoic foreign body with the localized bowel dilation by anechogenic fluid proximal to the foreign body in 86% (6/7), while abdominal palpation under anesthesia and simple abdominal palpation revealed firm foreign bodies in 60% (3/5) and 14% (1/7), respectively. This result underscores the usefulness of abdominal ultrasound to specifically diagnose colonic foreign bodies in chinchillas, although the application and utility of ultrasound would be limited in general for herbivorous mammals due to interference from the natural presence of gas and ingesta within the large intestine [25]. In fact, foreign bodies were not detected by ultrasound depending on the timing of examination in Cases 2 and 4. Ultrasound on multiple occasions may thus be essential to improve the detection rate for colonic foreign bodies in chinchilla. Plain abdominal radiography showed

mild to severe bowel dilation by gas or fluid. Positive-contrast abdominal radiography using barium sulfate suspension revealed clear prolongation of transit times in the digestive tract compared with reported mean retention times in the chinchilla digestive tract of 22.2 ± 5.3 hr for solutes and 25.4 ± 5.2 hr for particles, respectively [3]. Given the possibility of subsequent surgical interventions, other positive-contrast media such as sodium amidotrizoate meglumine solution should have been used instead of barium sulfate suspension, which can cause severe peritonitis if the material leaks from the bowel. In contrast to ultrasound, these radiographic findings were not specific for luminal obstruction, and were also consistent with severe hypomotility of the cecum and colon, dysbacteriosis, and tympany. This does not mean, however, that these radiographic findings exclude luminal obstruction, because tympany is often secondary to luminal obstruction and radiography with intestinal obstructions can reveal bowel dilation by gas and/or fluid proximal to the obstruction in chinchillas [14, 23]. In a chinchilla presenting with complete lack of fecal pellets, luminal obstruction should be considered among the differential diagnoses [8, 14–16, 18, 27]. In particular, rectal tissue prolapse and intussusception of the descending colon and rectum are known to occur frequently in chinchillas [8, 14, 15, 18]. However, diagnostic criteria for lower bowel obstruction in small hindgut fermenters have not been established, although a few case studies have suggested that the diameter of the dilated segment of intestine on radiography, positive-contrast colonogram, and/or abdominal ultrasound may be useful to diagnose colonic obstruction in rabbits to some extent [2, 6, 12]. This case series suggested abdominal ultrasound as the most useful tool to diagnose colonic foreign bodies in chinchillas and allow differentiation from other luminal obstructive diseases.

The potential mechanisms for the formation of a colonic foreign body and pathogenesis in the present cases remain unclear. One potential explanation is that the foreign body forms following the accumulation of material in the cecum, and then travels to the colon. A reasonable supposition in this case series was that the foreign bodies noted represented obstructions because all cases showed severe bowel dilation with luminal fluid proximal to the foreign body and distal collapse. The fact that Cases 1–4 showed fecal output soon after surgical removal of the foreign body also supports these cases being affected by colonic obstruction. Adhesion of adipose tissue, severe ischemia and necrosis, and thickening of the colonic wall containing the foreign body were noted in Cases 3, 5, and 7, respectively, suggesting prolonged obstruction of the foreign body at that site. The colon in chinchillas is divided into three parts: ascending colon, transverse colon, and descending colon [21, 26]. The ascending colon presents with three sections: proximal loop (ansa proximalis coli) with proximal and distal areas, simple intermediate part (pars intermedia), and a long distal ansa (ansa distalis coli) [1, 14, 21, 26]. The foreign body was noted at the distal ansa of the ascending colon in Cases 1, 2, and 5, and in the descending colon in Cases 3, 4, and 6. Cases 1, 2, and 5 underwent exploratory laparotomy 2 days after loss of fecal output. Conversely, Cases 3, 4, and 6 underwent exploratory laparotomy much longer (mean, 5.3 days; range, 5–6 days) after loss of fecal output. Such differences in obstruction site may suggest that colonic obstruction by foreign bodies in chinchillas tend to occur in the distal ansa of the ascending colon, and a prolonged time course, medical treatment including the use of prokinetic drugs, and assisted feeding may have resulted in distal travel of the foreign body. The distal ansa of the ascending colon in chinchilla is disposed in a very unique manner, formed by two loops running parallel to each other, joined by an apical flexure and the ascending mesocolon [1, 21, 26]. On the other hand, a variety of infectious and noninfectious factors for dysbacteriosis such as inappropriate diet, systemic disease, and painful condition may result in secondary digestive problems, including tympany and hypomotility of the intestine in chinchillas [8, 14]. The most common biochemical abnormality in the current cases was hyperglycemia, which could be attributable to painful conditions caused by foreign body obstruction and hepatic lipidosis. Hepatic lipidosis commonly develops secondary to excessive fat mobilization in anorexic chinchillas [14]. Such factors may thus have contributed to clinical conditions in this cases series.

We provided all cases with general medical treatment for nonsurgical gastrointestinal disease in chinchillas, including assisted feeding and administration of prokinetic drugs such as metoclopramide and mosapride citrate [14, 25]. In principle, these therapies are contraindicated in patients with true obstructive disease [8, 14, 25]. Nevertheless, assisted feeding and administration of prokinetic drugs are first required for the treatment of colonic obstruction by cecoliths (large lumps of impacted ingesta from the cecum) in rabbits along with general medical treatment because cecolith formation is a secondary problem of cecal impaction, intestinal hypomotility, and chronic dehydration [4, 5, 20]. A surgical approach is only undertaken if obstruction by the cecolith does not resolve with medical treatment [4, 20]. We prioritized medical treatment over surgical intervention, assuming hypomotility of the cecum and colon as a primary factor for the complete lack of fecal output in the early period of the current cases. Given the lack of response to medical therapy in all cases, surgical removal of a colonic foreign body in chinchillas may be necessary to achieve better prognosis in cases where medical therapy proves ineffective.

The perioperative survival rate was 71% (5/7) in this case series. In Cases 1 and 2, exploratory laparotomy was successfully performed without any anesthetic problems and the subsequent course was uneventful. We focused on the fact that the preoperative biochemistry in both cases showed normal to mildly decreased albumin. In contrast to Cases 1 and 2, Cases 3, 4, 6, and 7 at surgery showed severe edema, mild accumulation of ascites and collapse of peripheral blood vessels, most likely attributable to severe hypoalbuminemia due to prolonged malabsorption of nutrition from the bowel and hepatic lipidosis. Hypoalbuminemia can lead to life-threatening complications including hypotension, ascites, peripheral edema and gastrointestinal ileus, resulting in increased morbidity and mortality [7, 13, 28]. Acute postoperative death in Cases 6 and 7 can be attributable to perioperative hypoalbuminemia. Taken together, these clinical course and biochemical findings indicate that albumin should be considered as a useful tool for assessing perioperative risks in chinchillas with colonic foreign body.

Colloids have been studied and used in hypoalbuminemic rabbit to correct hypotension [9, 11, 17, 22]. Albumin is a natural colloid and HSA has been reported to increase serum levels of albumin and colloid osmotic pressure in dogs and cats [7, 13, 28]. Despite these benefits, administration of HSA has been controversial due to the potential for severe adverse hypersensitivity reactions [13, 28]. HSA was administered in Cases 3 and 4 at surgery resulting in increased albumin levels with distension of peripheral blood vessels, disappearance of edema, and subsequent successful outcomes. However, the potentially life-threatening complications of

HSA administration should not be ignored, although adverse reactions were not observed in either case during hospitalization or after discharge in terms of general condition or repeated hematological or biochemical findings. The current recommendation in dogs is that HSA should be administered only if the potential benefits outweigh the potential risks [28]. This should be more strongly followed in small exotic animals, for which no studies regarding the administration of HSA have been conducted [17].

In conclusion, this case series suggests that chinchillas are affected by colonic obstructive foreign bodies. Abdominal ultrasound is the most useful tool to diagnose colonic foreign bodies in chinchillas and albumin is considered a useful tool to assess perioperative risks. Surgical removal of the colonic foreign body may be necessary to achieve better prognosis in cases where medical therapy proves ineffective, although the potential mechanisms underlying the formation of a colonic foreign body and its pathogenesis remain unclear.

CONFLICT OF INTEREST. The authors declare that they have no competing interests.

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